УДК: 502.5:546.7:546.81

Student T.A. Moshina
Heads of scientific work L.V. Gurskaya, I.G. Pervova
USFEU, Ekaterinburg
Маг. Т.А. Мошина
Рук. Л.В. Гурская, И.Г. Первова
УГЛТУ, Екатеринбург

PROSPECTS FOR PHYTOREMEDIATION OFLAND REMEDIATION IN RUSSIA

ПЕРСПЕКТИВЫ ФИТОРЕМЕДИАЦИИ ДЛЯ РЕКУЛЬТИВАЦИИ ЗЕМЕЛЬ В РОССИИ

В работе представлена фиторемедиация как перспективная альтернативная технология для обезвреживания и восстановления техногенно загрязненных земель, предотвращающая дальнейшую миграцию экотоксикантов в экосистемах.

All industrial processes affect the environment and make use of a wide range of chemicals which can disrupt ecology. These chemicals can cause land contamination afterindustrial disasters or in case of activity industrial plants. The laboratory experiment carried out by us confirmed the presence of heavy metals of such lands. Russian experience in land remediation are time consuming, too expensive; this produce secondary waste and can create additional risks for human. One of the solutions is the developing cost-effective in-situ technologies for land treatment and contaminant stabilization. We find phytoremediation is the best solution for Russia. This method is widely used in foreign practice. Phytoremediation is a cost-effective method that could be an alternative for remediation of the contaminated land resources, it is ecological-friendly. Phytoremediation preserves diffusion of pollutants. However, it is necessary to take into account specifications of pollutants and contaminated lands when Phytoremediation is used.

Chaney was the first to suggest using plants for the phytoremediation of metal-polluted lands [1] and the first field trial of phytoremediation was done in 1991 on zinc and cadmium [2]. Boyd and Martens reported that the accumulation of metals could be a symbol of a defense mechanism against the pests [3]. Over the past 20 years, researchers have developed low-cost alternatives to clean up contaminated land. In a critical review, University of Birmingham environmental scientists Lesley Batty and Colette Dolan [4] conclude that such techniques could represent a cost-effective and sustainable option for remediating contaminated sites.

Phytoremediation is an alternative or complimentary technology that can be used along with or, in some cases, in place of mechanical conventional clean-up technologies that often require a big amount of investmentsand they are often labour-intensive and energy-absorbing. Plants can be taken together and disposed of in the normal way. As with other phytoremediation techniques this method is easier and less expensive than traditional methods of removing heavy metals. Phytoremediation is an eco-friendly, solar-energy clean-up technology, based on the concept of using natural constituents of the medium to cleanse this medium. Plant roots also cause changes on the soil-root surface as they secrete inorganic and organic compounds (root exudates) in the area around the roots (rhizosphere). These root exudates abject the number and activity of the microorganisms, the aggregation and stability of the soil particles around the root, and the availability of the contaminants. Root exudates can increase the availability of the contaminants in the rhizosphere of the plant through changes in soil characteristics, release of organic substances, changes in chemical composition, and/or increase in plant-assisted microbial activity [5].

Phytoremediation is a process in which contaminated land is decontaminated using plants that extract the metals from the soil and retain the metal in their tissues. Phytoremediation works better at sites with low or medium amounts of pollution. Plants remove harmful chemicals from the ground when their roots take ground watersand nutrients from polluted soil. Being inside the plant, heavy metal ions can be stored in the roots, stems, or leaves. When the plants have grown and absorbed the metal pollutants they are taken together and disposed of safely. The plant uptake of contaminants occurs primarily through the root. The root system provides an enormous surface area that absorbs and accumulates the water and nutrients essential for growth, as well as other non-essential contaminants. The phytoextraction process can be continuous (natural) using (hyper) accumulators or induced through the addition of chelates to increase the soil bioavailability. Phytoextraction processes extract both metallic and organic constituents from soil by direct plant uptakeand translocation to aboveground biomass using metal-(hyper)accumulating plants.Our experiments confirm that the heavy metals contained in the land can be transferred to higher terrestrial plants and can also accumulate in them. Nowadays the best studied hyperaccumulators (<0,2 % angiosperms) are: Brassica juncea, Brassica oleracea, Berkeyacoddii, Allysumbertolonii, Thlaspicaerulescens and Thlaspigoesingense. Likewise, numerous plants with potential hyperaccumulationor tolerance to metals have been discovered in Brazil, Chile, Cuba, the Dominican Republic and Venezuela and include Ni (89 %), Cu (5 %) and As (3 %) hyperaccumulators [6].

The use of plants in this application also helpstopprevent wind, rain, and groundwaters from carrying pollution away from sites to other areas since the plants stabilize the soil and the contaminants are less likely to be carried off [7].

With selective breeding and genetic modification of the plants, their natural ability to hyperaccumulate can be enhanced even further or, the hyperaccumulation ability of some plants may be transferred into other plants that would be better suited to specific locations. Therefore, it is possible to 'tailor' a plant to a specific pollutant and location.

Phytoremediation are technologies that use green or higher terrestrial plants for treating chemically- or radioactivelypolluted soils. These technologies permit the decontamination in-situ, preserve the topsoil, reduce the amount of hazardous materials generated during clean-up and have public acceptance. Thereafter, the polluted plants have a proper control of the disposal and could be used to generate energy. Some of the disadvantages of phytoremediation are related to the depth of the treatment and time expenditures.

Bibliography

1. Chaney, R. Plant uptake of inorganic waste, In: Land Treatment of Hazardous Waste (Eds: Parr J.E., Marsh P.B., Kla J.M.) Noyes Data Corp, Park Ridge, 50–76. 1983.

2. Baker, A.J.M., Reeves, R.D., McGrath, G. P., In situ decontamination of heavy metal polluted soils using crops of metal accumulating plants- a feasibility study, In; insitu Bioreclamation (Ed: Hinchee), Stohneham, 539–544. 1991.

3. Boyd, R.S., Martens, S.N., Nickel hyperaccurnulated between Thlaspi and Montanum is acutely toxic to an insect herbivore, Oikos, 70, 21–25. 1994.

4. Critical Reviews in Environmental Science and Technology Journal news43:217-59, 2013.

5. Krämer, U. Phytoremediation: novel approachesto cleaning up polluted soils. Current Opinion in Biotechnology, v. 16, p. 133–141, 2005.

6. Ginocchio, R. Effects of a copper smelter on a grassland community in the Puchuncavi Valley, Chile. Chemosphere, 41, 1–2, p. 15–23, 2000.

7. Merkl, N.; Schultze-Kraft, R.; Infante, C. Phytoremediation of Petroleum-contaminated soils in the tropics- Pre-selection of plant species from eastern Venezuela. Journal of Applied Botany and Food Quality, v. 78, p. 185–192, 2004.